Final Report

A project under the Canada
New Brunswick Conservation
and Renewable Energy
Demonstration Program

JIFFY PRODUCTS (N.B.) LTD.

SHIPPAGAN, N.B.

March, 1985

CREDA Project #2010

Prepared by: Bernard Morin

Canada/New Brunswick Conservation and Renewable Energy Demonstration Program

The Conservation and Renewable Energy Demonstration Program Program is administered in New Brunswick by the Energy Secretariat and managed jointly with Energy, Mines and Resources Canada. The Program is designed to help demonstrate promising conservation and renewable energy technologies, to develop public awareness and understanding of these technologies, and to create employment in new or existing industries.

Through over 100 demonstration projects in New Brunswick, a wide variety of conservation and renewable energy technologies have proven to be technically sound and economically attractive. These demonstration projects should now provide a catalyst for commercialization and lead to widespread adoption of many of these proven technologies.

This final report is based on a project which was financially supported by the Energy Demonstration Program. For further information on other demonstration projects funded in New Brunswick under this program, contact:

Conservation & Renewable
Energy Division
Energy Secretariat
P.O. Box 6000
Fredericton, N.B.
E3B 5H1
(506) 453-3897

Programme Canada/Nouveau-Brunswick de démonstration des économies d'énergie et des énergies renouvelables

Le Programme de démonstration des économies d'énergie et des énergies renouvelables est administré au Nouveau-Brunswick par le Secrétariat à l'énergie, en collaboration avec Energie, Mines et Ressources Canada. Ce programme tente d'abord de vérifier la fiabilité des techniques de conservation d'énergie, d'accroître la sensibilité du public envers ces techniques et, enfin, de favoriser la création d'emplois au sein des industries nouvelles ou déjà existantes.

Un grand nombre de projets de démonstration se sont avérés à la fois techniquement réalisables et économiquement attrayants.

Le succès ainsi rencontré encourage la commercialisation des procédés les plus accessibles. Cela entraînerait certes l'adoption d'un grand nombre de ces techniques par les propriétaires de domiciles et par l'industrie privée.

Ce rapport final est basé sur un projet qui a reçu une aide financière du Programme de démonstration. Pour de plus amples renseignements, communiquez avec la:

Division des économies d'énergie
et des énergies renouvelables
Secrétariat à l'énergie
C.P. 6000
Fredericton, N.-B.
E3B 5H1
(506) 453-3897

D I S C L A I M E R

This report, funded by the New Brunswick Energy Secretariat and Energy, Mines and Resources Canada, is published as a public service for the information of the public. The parties do not, however, warrant the accuracy of its contents and cannot guarantee or assume any liability for the effectiveness of economic benefits of the devices and processes described in the report or that their use does not infringe privately-owned rights.

D E N I D E R E S P O N S A B I L I T E

Ce rapport, financé conjointment par le Secrétariat à l'énergie du Nouveau-Brunswick et Energie, Mines et Ressources Canada, est publié à titre de service public. Les gouvernements fédéral et provinciaux n'assurent aucunement l'exactitude du contenu, l'efficacité des appareils et des procédés et, enfin, les économies que préconise le rapport. L'utilisation de ces systèmes de conservation d'énergie ne doit, à aucun moment, empiéter sur les droits d'autrui.

TABLE OF CONTENTS

1.0 Executive Summary - English.....p.1
- French.....p.2

2.0 Introduction and Background.....p.3

3.0 Description of Demonstration.....p.4

4.0 Observations During Installation and Monitoring....p.7

5.0 Cost/Benefit Analysis.....p.10

6.0 Conclusion.....p.11

7.0 Recommendations.....p.12

1.0 EXECUTIVE SUMMARY

The main objective of this project was to take energy from our dryer exhaust and reuse it in our dryers to lower gas consumption, and to remove very high humidity air from the building and replace it with hot dry air supplied from the heat wheel.

The technology applied in this project was a standard heat wheel, used to recuperate and reuse the energy from our dryers.

The project was neither a complete success or a complete failure. We did prove that the heat wheel method would transfer energy as planned, but the environment in our plant is dusty and corrosive, and the air contains a high level of humidity. As a result, after approximately two years in operation the heat wheel is not completely satisfactory. This is largely due to contamination and damage to the wheel itself.

Other problems encountered were that the dryers which were used for the experiment were not designed to incorporate additional energy. When additional heated air from the heat wheel was injected into the return air of the dryers, the air flow inside changed drastically and we were not able to control dryer performance.

1.0 SOMMAIRE RECOMMANDATION

Le but principal de ce projet était de transférer l'énergie de la sortie de notre sécheuse afin de la réutiliser dans nos sécheuses de façon à réduire la consommation de gaz et l'humidité très élevée de l'air dans le bâtiment pour le remplacer par de l'air chaud sec provenant de l'échangeur rotatif.

La technologie mise en application en vertu de ce projet consistait à installer un échangeur rotatif standard et à récupérer l'énergie de nos sécheuses pour la réutiliser.

Le projet n'a été ni un succès ni un échec. On a pu démontrer que la technologie de l'échangeur rotatif a permis de transférer l'énergie comme prévu, mais l'environnement dans notre usine est poussiéreux et corrosif, et l'air contient un degré d'humidité élevé.

Finalement, au bout de deux ans d'utilisation, l'échangeur rotatif n'offre pas de résultats satisfaisants. L'intérieur est endommagé ou plein de particules de tourbe.

Parmi les autres difficultés, on peut noter le fait que la sécheuse servant à l'expérience n'avait pas été conçue pour incorporer de l'énergie additionnelle. Lorsque de l'air réchauffé de l'échangeur rotatif était injecté dans l'air retournant dans la sécheuse, le débit de l'air était considérablement modifié et nous n'étions pas en mesure de contrôler le rendement de la sécheuse.

2.0 INTRODUCTION AND BACKGROUND

The heat recovery project was conceived to recuperate all the energy possible from our dryers' exhaust and return the energy into our dryers as a method of reducing the gas consumption, and to condition the air in the factory.

A consulting firm was hired to prepare plans and choose a method to recover the energy. After many consultations with many different types of heat recovery firms, the consultant and Jiffy agreed to try the heat wheel concept which at that time appeared to be the best solution for the funds available.

The size of the unit was chosen by the consultant with the help of the wheel supplier.

Other alternatives such as cross-flow methods were also looked at but the advantage of the heat wheel was that is was supposed to condition the air in the factory and return the energy to the dryer with a relatively higher recovery efficiency. It was felt that a commercial dehumidifier could condition the air inside the factory but the capital and operating costs of the dehumidifier were too high compared to the heat wheel method.

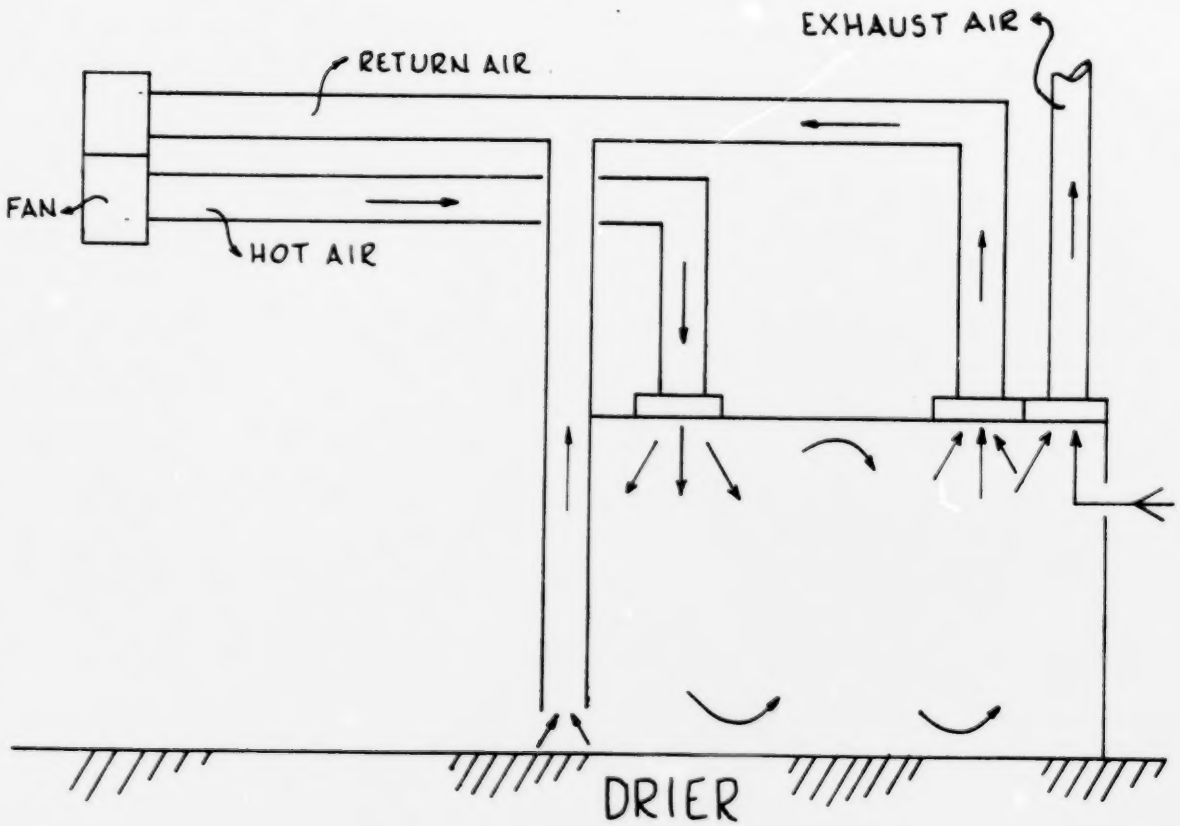
The energy impact forecast was a reduction in propane consumption of approximately 15-20%.

3.0 DESCRIPTION OF DEMONSTRATION

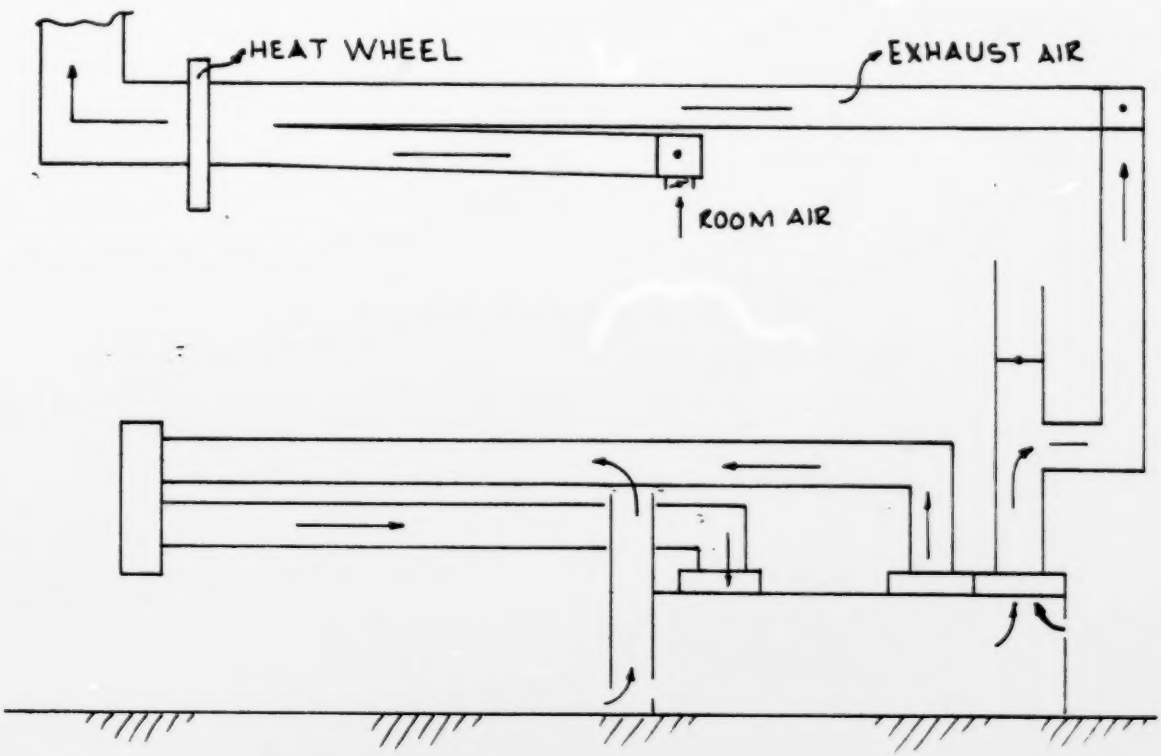
The system is basically divided into three parts:

1. A source of heat loss;
2. a system for recovery of that heat;
3. a system to use the recovered energy.

The first part consists of five dryers. The following figure shows dryer layout.

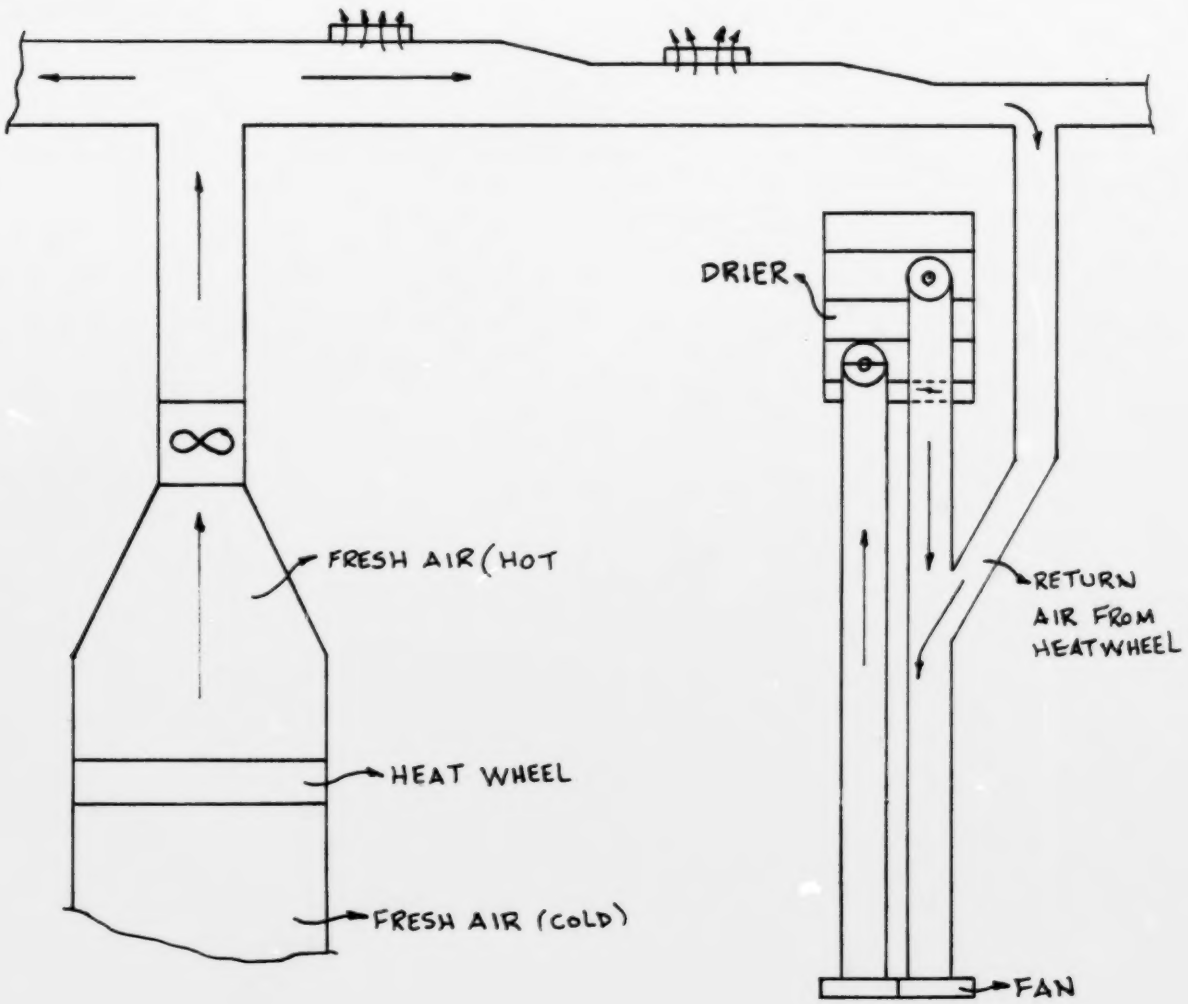


The heat recovery system collects the exhaust air from the five dryers into one plenum, and passes it through a heat recovery unit before exhausting to the atmosphere. The heat recovery unit chosen was a heat wheel from Wing Company, a division of Wing Industries Inc. The wheel is 10 ft. in diameter, made out of stainless steel with a variable speed motor. The following figure shows the heat recovery system.



The exhaust is a blend of exhaust air from the five dryers and room air at ceiling level. This was necessary because of excess radiant heat generated by the dryers. Exhaust system balancing was also required.

The last task was to heat fresh air and use it in the drying process. The concept was to use fresh air with low water content and pass it through the heat wheel in order to reduce the operating temperature of the dryer, thus reducing energy cost. Also, part of that fresh air would be used to condition the air environment of the plant. The following figure shows the set-up for a first trial at returning air to the dryers.



4.0 OBSERVATIONS DURING INSTALLATION AND MONITORING

4.1 Installation

The first experience with the heat wheel was with a different supplier. The model bought was made of regular steel and was not adequately supported by its center bearing. Eventually the wheel had to be sent to the supplier for repair. The bearings were worn out and the wheel was starting to rust after six months in the corrosive atmosphere. We decided to use another model from a different supplier (Wing Co.). This time we went with a complete stainless steel wheel with better supporting bearings.

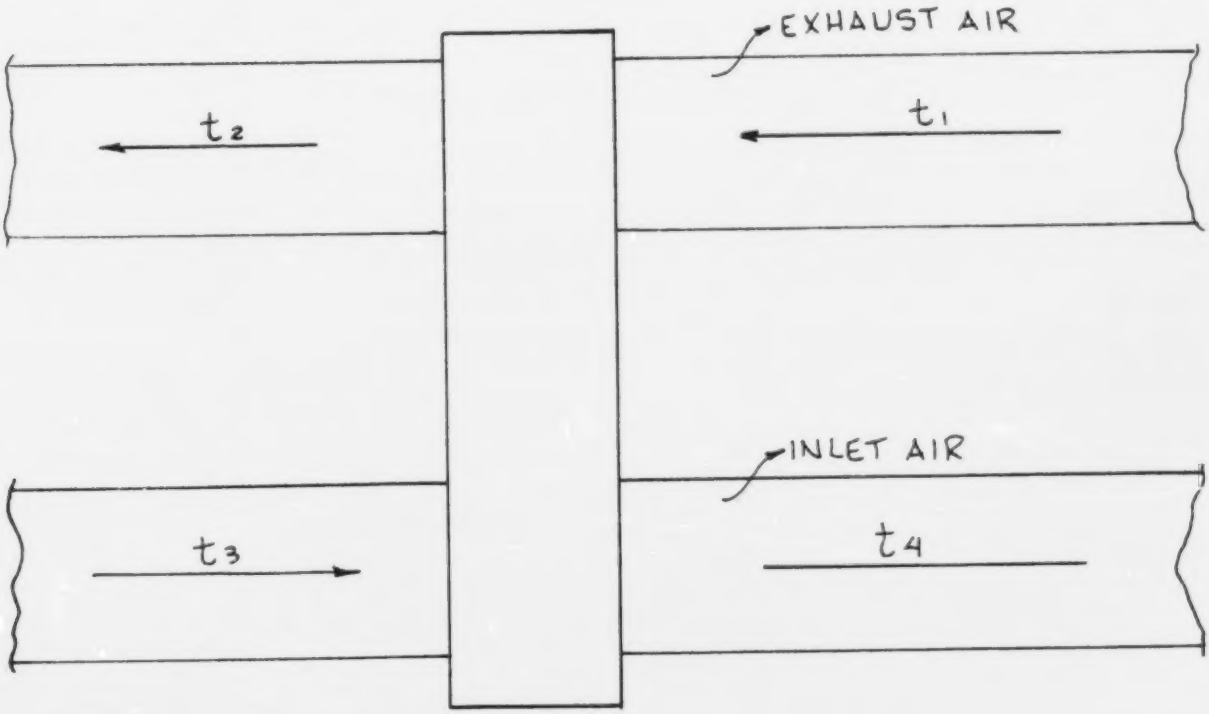
Notice though that a good filtering system was required on the exhaust stream because of the concentration of very fine peat fibers in the exhaust air from the dryers.

Instruments were installed to monitor the cleanliness of the filters and we found a set of filters did not last more than two (2) weeks. Even then, after two years of operation the wheel is filled with peat dust. The honeycomb design of the wheel makes it very hard to clean. There is a self clean attachment on the wheel but that did not clean the wheel adequately. Another item which failed was the motor; at ceiling level the temperature in our plant could very well be around 35° C with 100% relative humidity.

4.2 **Monitoring**

Measurements on the wheel efficiency were made twice. The first time was during winter and we found that the incoming fresh air was hot but also very humid. This caused the plant relative humidity to go up to a level which was not tolerable for working conditions, so we had to postpone the study.

On March 4, 1985, a complete test was made for a full 8 hours. We were able to change some parameters to see if it would affect the test results. The following represents the average readings with the minimums and maximums for that day.



	Min.		Average		Max.	
	C	T	C	T	C	T
t1	38	-28	51.4	-21.4	78	-32
t2	10		30		46	
t3	-6	+29	0	+29.7	9	+24
t4	23		29.7		33	
RH1	15%		20%		25%	
RH2	-		-		-	
RH3	-		5%		-	
RH4	95%		98%		100%	

The discovery that the air return to the dryers had high humidity content caused concern since a major reason for using the wheel was to bring hot dry air into the system.

5.0 COST/BENEFIT ANALYSIS

The total cost for the project was $95,548. Of the total, 39% was provided by CREDA.

Capital cost for the project was approximately $45,000, installation cost was $15,000, engineering approximately $20,000.

Due to the fact that the project was not a complete success, there are no tangible economic benefits. The only benefit is that it helps to improve the working conditions in the plant.

6.0 CONCLUSION

In conclusion, the overall objective has not been met due to the following:

1. There is still too much humidity in the return air from the heat wheel.

2. Peat dust particles are clogging up the small heat wheel holes, creating a vacuum on the fan side, therefore crushing the honeycomb material in the wheel core. To completely remove the fine particles, it would take HEPA absolute filters which are too expensive. Presently used are ordinary filters, which are not adequate.

3. The actual design of our dryers could not be adapted as planned, because forcing air into the dryer as planned created an imbalance in the dryer.

The project has also demonstrated the importance of finding a consulting firm with specialized knowledge of our environment and process. We were not at all satisfied with the work performed by the consultant. However, it was proven that the heat wheel has the capacity to exchange energy.

7.0 RECOMMENDATIONS

We would not recommend a heat wheel for a heat exchanger in our process and plant environment for the reasons discussed above.

A cross flow exchanger which could be periodically washed would be a better solution; there would be no air contamination at all. The only disadvantage would be a lower heat exchange efficiency.

Each dryer should have an independent heat exchanger which would permit more flexibility in adjusting and balancing the air flow in the dryers.

As for the plant environment, an air dehumidifier would be the ideal solution.